Time Scale Relativity of Objective Imprecise Probability

Marshall Abrams MABRAMS@UAB.EDU
Department of Philosophy, University of Alabama at Birmingham, United States

Background: Chance Setups Inferences and generalizations about probabilities in statistical mechanics, biology, and social sciences often seem to require that probabilities be objective features of the world, though in most such cases the underlying processes seem to be deterministic. In philosophical discussions of such probabilities, it's often assumed that there can be (precise) "chance setups": sets of physical conditions that (a) realize axioms of probability, such that (b) when the conditions are repeatedly realized, they often result in outcomes with relative frequencies close to probabilities (e.g. Hájek 2019). (Note trials need not be independent.) Unlike the chance setup realized by a Geiger counter near a radioactive source, a person tossing a coin realizes a chance setup in which causal interactions leading up to the outcome may be deterministic; the coin tosser also realizes a more fine-grained set of properties relative to which the probability of heads may be near 0 or 1 rather than 0.5. Such ideas can be motivated in part by fundamental problems with the view that all physical probabilities are relative frequencies (Hájek, 2019), and by the need for probabilities to play roles required by the widespread use of (so-called) frequentist statistics. Some authors simply assume that there are deterministic processes that behave as chance setups (Hájek, 2019); others (e.g. Abrams 2012) argue that they require particular causal structures.

Imprecise Chance Setups Among numerous proposals concerning imprecise objective probabilities, some can support the idea of an imprecise chance setup, i.e. a set of properties that realize some set of axioms for imprecise probabilities (e.g. Fierens et al. 2009; Suppes and Zanotti 1996; Abrams 2019). As a with a (precise) chance setup, the underlying processes may be deterministic, and an instance of an imprecise chance setup might simultaneously realize a different set of properties that give outcomes other, perhaps precise probabilities. What pattern of outcomes should we expect from trials of an imprecise chance setup? A natural answer is that no matter how many trials there are, relative frequencies usually should, at the very least, fluctuate within or near upper and lower values (e.g. Fierens et al. 2009). For this to occur, repetitions of the setup must produce longer and longer subsequences of consecutive trials in which some outcomes predominate over others, or produce subsequences in which relative frequencies differ to greater degrees But such increasingly divergent subsequences have little relevance to science, where trials cannot be extended indefinitely. Thus I propose that a practical concept of chance setup—whether precise or imprecise—should often be relativized to a time scale, in the sense that whether a chance setup is precise or imprecise should be viewed as relative to the number of trials considered, or to a length of time or a spatial region, if trials occur continuously. An imprecise chance setup is then one in which the patterns of outcomes over the short or medium term are not usually systematic enough that a chance setup generating them would usually be considered precisely probabilistic.[1]

References

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1. Though algorithmic concepts of randomness are relevant to some precise chance setups by specifying probable patterns of outcomes along complex subsequences, de Cooman and De Bock's (2017) imprecise generalization is not directly relevant here because of its exclusive focus on infinite sequences.